

observe them at leisure. Not all of them had the same intensity of chestnut on the head and on the chin and bib. There were another five feeding a little further on. They all had some yellow on the undersides. Those with brighter chestnut heads had a stronger shade of yellow underneath. The beak was distinctly conical and the tail slightly but noticeably forked.

H.A. was almost certain it was the Red-headed Bunting and the following day he confirmed the identification stating that the:

The Redheaded Bunting (*Emberiza bruniceps* Brandt) is a winter visitor to India, fairly common in Gujarat and in the Deccan as far south as Cudappah, Mysore and Coimbatore. There are, however, no records of this species from the Bombay area where

the Blackheaded Bunting (*E. melanocephala* Scopoli) with which it is often associated, is common particularly in the Konkan during February and March.

On March 4, one Redheaded Bunting was seen in the same area. It was not shy. The yellow rump was easily visible when it hopped onto a water pipe. When feeding on the ground the yellow rump is concealed by the folded wings. Further away towards the seaward end of the Course a party of thirteen was seen. Four had rich chestnut heads, the colour extending below the chin into an untidy bib. The rest were grey-brown near the beak and fading into a dull grey at the outer limits of the crown and throat but all showed some yellow below. Seven were seen in the same area on April 11, and four on May 6.¹

12 REVATI,
NAVY NAGAR,
COLABA,
BOMBAY 400 005,
June 10, 1980.

JASJIT MAN SINGH

¹ As a postscript the birds have been again found in the same area in March 1981 on two occasions—in groups of three and four.

15. AGE AT ONSET OF SEXUAL MATURITY IN MALE INDIAN MUGGER (*CROCODYLUS PALUSTRIS*, LESSON) REARED UNDER IDEAL HUSBANDRY CONDITIONS IN CAPTIVITY

INTRODUCTION

Captive crocodiles maintained under ideal husbandry conditions show extremely rapid growth (see below and Bustard, Singh & Choudhury, in press). It might be expected that this would lead to early onset of sexual maturity. Whitworth (1971) cites an instance of a female alligator (*Alligator mississippiensis*) which exhibited an extremely rapid rate of growth in captivity, and mated, nested and produced eggs at 4 years of age, i.e. over five

years younger than the normal age of sexual maturity in the wild (McIlhenny 1934 and Cott 1961). Joanen and McNease (1975) also concluded that in the alligator sexual maturity is dependent on size rather than age, and Nichols & Chabreck (1980) consider that enhanced feeding, leading to much faster growth, can result in earlier breeding in the alligator.

This paper investigates the relationship between growth rate and attainment of sexual maturity in a crocodile species—the Indian mugger (*C. palustris*).

MATERIALS AND METHODS

A group of five hatchling mugger was obtained from Hogganakal Water Falls (12°7'N, 77°80'E) on Cauvery River in Dharmapuri District of Tamil Nadu, and brought to the Gharial Research and Conservation Unit at Tikerpada, District Dhenkanal, Orissa, for captive rearing on 14 August 1975. This group had hatched during April 1975. They were reared under the rearing conditions described by Bustard (1975) and Bustard, Singh and Choudhury (in prepn.).

Tikerpada and the adjacent Mahanadi River are in the natural habitat of the mugger and three wild individuals are known to presently inhabit the adjacent stretch of the Mahanadi which during the floods comes to within 25 m of the Research Centre.

RESULTS

Growth was rapid under the ideal husbandry conditions prevailing (Bustard, Singh and Choudhury, in prepn.) and presumed breeding size of 1.62 to 1.73 m was obtained by four males after two years and six months by which time the penes of the males were greatly enlarged (at least 10 cm). No female mugger of comparable size were available in the Unit to conclusively prove copulation and successful insemination of females at this age. However, strong corroborative evidence of their sexual maturity was obtained from the following indirect evidence:

1. From December 1977, a wild female mugger living in the adjacent stretch of the Mahanadi river was repeatedly attracted to the rearing enclosure at the centre which held the males (mean length 1.64 m). This behaviour was very frequent in December 1977 and January to February 1978, (the 1977/78 breeding season) and again from November

1978 to January 1979 (when this female was captured) (Singh 1979, Singh and Bustard, in prepn.). The attraction is considered to result from olfactory stimuli from the male mugger in the Centre which may have reached the female in the river via water drained out of the pools.

The attractiveness of these male mugger to the female in the adjacent river suggests that they had attained sexual maturity by the age of two years and six months.

2. Following her capture, frequent courtship and mating was observed during February 1979 by the two males of May 1975 stock retained at the Centre. This is further strong evidence that the two males were sexually mature. However, at the time of these actual matings (following the capture of the female) the males were three years and eight months old and between 1.7 to 2.1 m length.

No eggs resulted from these matings in the 1979 breeding season. However, this could be due to sexual incompatibility or other factors (Singh and Bustard, in prepn.) and not due to inability of the males to successfully inseminate the female.

DISCUSSION

Taken together, the above data suggest that these two male mugger had probably attained sexual maturity at 2½ years old (mean length 1.64 m) and certainly by about 3½ years old (mean length 2.09 m). It is our belief that these mugger could have successfully mated had suitable females been present during the December 1978—February 1979 mating season at an age of three years and six to eight months.

The youngest definitely recorded breeding age for the female Indian mugger at present is six years (Choudhury, in prepn.) and six or seven years (Whitaker, pers. comm.).

MISCELLANEOUS NOTES

These data indicate that attainment of sexual maturity, in atleast some races of the Indian mugger, can occur remarkably quickly. This finding has two important implications:

(a) A practical application in the development of crocodile farms. A crucial handicap in the use of saltwater crocodile (*Crocodylus porosus*) is that individuals of this species take approximately 10 years (12 to 15 years; Yangprapakorn 1971) to reach sexual maturity. This means that a long period has to be devoted to building up the captive breeding herd before any breeding takes place. The fast breeding, of at least some mugger strains, would overcome this difficulty. Growth in captivity in this species can also be excellent (Bustard, Singh & Choudhury, in prepn.).

(b) Ecological resilience of the species. If, under ideal conditions in the wild, early onset of sexual maturity and breeding is a possibility, the survival prospects for the species will be enhanced. Indeed, early onset of sexual maturity in the mugger, as compared to the much larger gharial (*Gavialis gangeticus*) and saltwater crocodile (*Crocodylus porosus*), a phenomenon seen in most if not all of the smaller crocodilian species, is undoubtedly one reason for the better survival of this species in India at the end of the heavy hunting phase.

These limited data are noteworthy as they

are based on the 'grow and release' technique (Bustard 1974, 1975) under which crocodiles are grown under ideal husbandry conditions for quick release back into the wild. Most captive crocodiles in Indian and overseas zoos are kept under distinctly suboptimal husbandry conditions and as a result exhibit greatly reduced growth compared to what is possible. Consequently the onset of sexual maturity may be retarded by many years. Unfortunately such data come to be accepted as the norm.

The whole topic of size/age/sex relationships is in need of attention (Bustard, in prepn.). It is not known if there is an age or size 'over-ride' in crocodilians, that is, if crocodilians have to attain a certain age before they can breed irrespective of their size. The above data suggest that breeding can perhaps be speeded up following very fast juvenile growth and that there is probably not an absolute age 'over-ride'. These results are more noteworthy since they are achieved with males which one might expect to attain sexual maturity later than females, a point also made by Cott (1961), Yangprapakorn (1971) and B. C. Choudhury (pers. comm.). This is clearly a topic on which further research is required. Data are being assembled by our group on all three species of Indian crocodilians but this will take some years.

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16. GHARIAL ATTACKS ON MAN

Malcolm Smith (1931) stated of the gharial, "Very occasionally they will attack man, but they are not much feared on this account."

In over 6 years' experience, we know personally of only one attack on man by a gharial. The details of this attack are set out below together with information on three other 'attacks' which we have been told about during survey trips.

On 14th November 1979 at Tasera on the Mahanadi river in the Satkoshia Gorge Sanctuary of Orissa, an old man, Sankara Behera, aged 55 years, had his left arm caught by a young male gharial, 3-3.7 m in length, while Sankara was washing his utensils in the water from the river bank. The gharial, probably waiting to emerge at this preferred basking spot, was not observed by Sankara as the water was turbid due to waves washing the bank. The old man was either pulled or slipped into the river but the gharial did not retain its hold on his arm. Fortunately the old man's son, Barju Behera seeing the predicament of his father, came to his rescue in a canoe and pulled him by his hair into the boat. As the son dragged his father into the boat the gharial again caught the man by his right thigh and released him immediately. The man was hospitalised and recovered.

Both of us have seen Sankara subsequently and can testify to the extensive scars on the

left forearm and right thigh resulting from lacerations caused by the fish-holding (piercing) teeth of the gharial's elongated jaws.

Information on three other attacks, all in Orissa, reported to us, is set out below:

1. A female gharial was known to be guarding its nest on the river bank at Naraj on Mahanadi river. The attack took place prior to 1974, when a visitor to the riverside village went down to the water's edge after nightfall to take his bath in the river. The local villagers knew and avoided that exact spot where the female gharial was guarding its nest, located in the sandbank near the water's edge. The visitor, unaware of the nest, approached this site and had his ankle 'nipped' by the nest-guarding female. No injury was sustained—probably the gharial was merely trying to warn him away from the nesting site as is known to occur in *C. porosus* (Bustard and Choudhury 1980).

2. Around 1974 a local fisherman, also from Naraj village was bitten in the chest area when he dived under water to release his fishing nets which had become snagged on what he thought to be some rocks. He was immediately released and sustained only minor injuries.

3. A similar incident happened about twentyfive years ago to a fisherman near Talchar on the banks of the River Brahmani,